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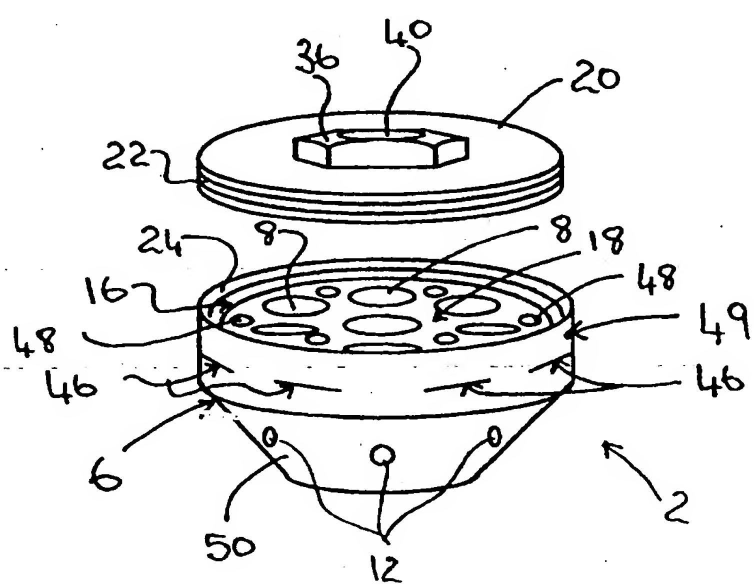
(54) Title: NOZZLE

(57) Abstract

A nozzle (2) for spraying liquid having a housing (6), swirl chambers (8) and swirl jets (10) provided in the swirl chambers (8). The housing (6) is provided with outlet orifices (12) corresponding to each swirl chamber (8). Liquid delivered to the nozzle (2) travels into the swirl chambers (8) and is atomised by the swirl jets (10) and results in the liquid being sprayed from the outlet orifices (12) as a mist.



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TITLE

"Nozzle"

FIELD OF INVENTION

The present invention relates to a nozzle.

The nozzle of the present invention finds particular, although not exclusive, application in fire fighting apparatus which uses a non-flammable liquid, such as water, for extinguishing a fire, including Class A, B and C fires.

Class A fires are fires fuelled mainly by fibrous fuels, eg wood, paper and cloth. Class B fires are fires fuelled mainly by hydrocarbons, eg chemicals, petrol and oils. Class C fires are electrical fires.

BACKGROUND OF THE INVENTION

In fighting fires it is known that there are three major contributing factors to the continuation of the fire. These factors are heat, oxygen and fuel. This relationship is shown pictorially in figure 1. When extinguishing fires, fire fighters act to remove at least one of the three factors necessary for combustion. Typically, fire fighting agents such as water, Halon or carbon dioxide, as three examples, can be used as fire fighting agent. Water acts on the fire by removing the heat from the fuel, whilst carbon dioxide works by displacing the oxygen.

Another aspect of combustion is a chain flame reaction indicated by the circle which contains the triangle shown in figure 1. The chain flame reaction relies upon free radicals which are created in the combustion process and are essential for its continuation. Halon, for example, operates by attaching itself to the free radicals and thus preventing further combustion.

The main disadvantage of using water is that often considerable amounts of water are required to extinguish a fire which leads to considerable damage by the water. Also, in some instances suitable quantities of water required to extinguish a fire are not available.

Gases such as carbon dioxide and Halon are often used to extinguish fires. Both have the disadvantage that the area in which they are to be used must be evacuated since it will become impossible to breathe. For this reason, fire fighters using gaseous extinguishing agents must use breathing apparatus. Also, Halon has a further disadvantage in that it is highly toxic and very damaging to the environment. For those reasons, the use of Halon in extinguishing fires has been banned under the Montreal Protocol and its manufacture and use are no longer permitted.

Another disadvantage of using carbon dioxide and Halon gases to extinguish fires, particularly in large spaces such as buildings, is the large volumes of gas required. Typically, it is required to fill a space, such as a building, where a fire is situated with carbon dioxide to a saturation level of approximately 87%. Typically, this means the use of many carbon dioxide cylinders connected via a manifold pipe work to distribution lines containing nozzles.

Typically, when Halon is used to extinguish a fire in a space it is required to fill the room with between 5% to 7% saturation level. Typically, this means the use of many Halon cylinders connected via a manifold pipe work to distribution lines containing nozzles.

A further disadvantage of using gaseous fire extinguishing agents such as carbon dioxide and Halon is their relatively high costs.

A further disadvantage of using gaseous agents to extinguish fires in spaces is that it is required to close or shut all doors and ventilation points. Excessive

ventilation in a space will not yield satisfactory results when attempting to extinguish a fire using gases such as carbon dioxide or Halon.

A further disadvantage of using gaseous agents, such as carbon dioxide and Halon, to extinguish a fire is that gases offer very poor cooling qualities on hot objects. For example, if a hydrocarbon fuel sprays directly onto a hot engine exhaust manifold from a ruptured fuel line, it will cause re-ignition. This will lead to a phenomena known as flashover.

An alternative fire fighting technique which avoids the disadvantages of the techniques previously hereinbefore described is based upon the generation of a relatively fine mist of non-flammable liquid, such as water, to reduce the heat of the vapour around the fuel, reduce the heat of the fuel, displace the oxygen and interrupt the flame chain reaction. That is, the liquid attacks all parts of the combustion process except for removing the fuel. The fine mist non-flammable liquid displaces the oxygen, and upon heating, evaporates and expands to further displace the oxygen. Upon expansion, the liquid absorbs heat from the vapour around the fuel and also from the fuel. In addition, the mist interrupts the flame chain reaction. Consequently, the mist has a smothering effect and a cooling effect upon the fire. For these reasons, the mist has the surprising result that water can be used as the non-flammable liquid to safely extinguish not only class A and class B fires, but also class C fires, ie electrical fires. Thus, the use of a non-flammable liquid mist is not a conventional water on flame scenario.

Typically, non-flammable liquid mist fire extinguishing systems are used to extinguish fires by propelling a fine mist of the non-flammable liquid, which may be water, into a fire incident. Typically, the non-flammable liquid is pumped under elevated pressure through a network of piping and then through a number of nozzles. When expelled under pressure through the nozzle(s), the non-flammable liquid atomises into finer droplets. The incident area becomes saturated with water mist thereby extinguishing the fire. Typically, these systems utilise a network of distribution lines. If the space to be protected is relatively

large, a distribution network of piping with a plurality of nozzles is required. Typically, the network of distribution pipes is a fixed installation, meaning it is not portable.

There are a variety of non-flammable liquid mist systems available on the international market. Most of these utilise nozzles with a single orifice from which the mist is sprayed.

A disadvantage of using single orifice mist nozzles within a non-flammable liquid mist system is their inability to provide a wide spray pattern coverage, and optimal flux densities cannot be easily achieved to guarantee fire extinguishment. Where single orifice nozzles are used, the system design will necessitate the use of many nozzles to yield optimal coverage and resultant flux densities. Within a fire incident area, use of many single orifice nozzles entails a closer grid pattern of nozzles and hydraulic distribution lines which is expensive to install and is not aesthetically appealing. A plurality of non-flammable liquid distribution lines means that the system is also heavier which is a disadvantage in some locations, for example, if installing such a system on board a high speed passenger ferry.

As an alternative to the use of single orifice mist nozzles in a non-flammable liquid mist system, several systems utilise multi-orifice nozzles. Such multi-orifice nozzles yield a wider spray pattern coverage per any one nozzle and enhanced flux densities whilst being aesthetically appealing at the same time, meaning less nozzles need to be installed within the same fire incident area. These multi-orifice nozzle systems have been designed with inherent design characteristics to suit the particular individual systems. Two examples of such multi-orifice nozzles are the Heien-Larsen and Marioff OY Hi-Fog mist nozzles, which is the subject of International Patent Application Publication No. WO 92/20453 (PCT/FI92/00155)

The Heien-Larsen mist nozzle works on the principle of nozzle rotation. The Heien-Larsen mist nozzle is a multi-orifice nozzle which creates water atomisation under elevated pressure when the nozzle rotates. However, this nozzle relies for its operation on rotational motion. If the mechanism jams, then the non-flammable liquid is not atomised and the mist is not generated. This makes the nozzle ineffective.

The Marioff OY Hi-Fog mist nozzle achieves atomisation under extremely elevated pressures of typically up to 150-200 Bar pressure. The Marioff OY Hi-Fog nozzle has multiple moving parts and also relies upon rotation of atomising jets to achieve atomisation and so is also susceptible to the jamming problems of the Heien-Larsen mist nozzles. The Marioff OY Hi-Fog nozzle employs atomising jets which are screwed in from the outside of the nozzle with inherently fine orifice diameters for atomisation of the non-flammable liquid.

Typically, multiple orifice water mist nozzles are known to provide a reasonable spray pattern coverage and water distribution flux densities into a fire incident area. The ability for increasing the flux density while at the same time for improving water mist trajectory, spray pattern coverage and causing deeper penetration into the fire plume at considerable distances of up to 5 to 10 metres from a typical water mist nozzle is not easy.

Attempting to increase flux densities and water flow rates, whilst aiming to create a wider spray pattern and deeper fire penetration by attempting to increase operating pressures, for example, seems to yield negligible advantages. For example, by increasing the optimal design pressures of a nozzle causes the spray patter to "vortex" in a predominantly conical spray pattern. This means that nozzles and hydraulic distribution lines need to be placed even closer together to create mist overlap to ensure proper flux densities to effect fire extinguishment. This has a disadvantage as identified earlier.

Furthermore, it is difficult to achieve a uniform horizontal 360° wide mist spray pattern at ceiling level while at the same time creating a vertical spray pattern. Most current water mist nozzles are vertical discharge types, meaning that their spray patterns are equal to or less than 90° angle if the nozzle is affixed perpendicular to the ceiling.

SUMMARY OF THE INVENTION

In accordance with one aspect of the present invention there is provided a nozzle for spraying liquid comprising a housing, chambers provided in the housing, jet means provided in a respective chamber, the housing having outlet orifice means corresponding to each chamber, wherein liquid delivered to the nozzle travels into said chambers and is atomised by the jet means such that liquid is sprayed as a mist from the outlet orifice means of the nozzle.

Preferably, at least three chambers are provided in said housing.

Preferably, said outlet orifice means comprises an outlet orifice such that said liquid can be sprayed from each said chamber via its corresponding said outlet orifice.

Preferably, said jet means are stationary in said chambers, in use.

Preferably, said jet means are removably retained in respective said chambers.

Preferably, the nozzle is provided with a liquid entry chamber which receives liquid introduced into the nozzle via an inlet.

Preferably, openings are provided in said liquid entry chamber which connect to outlet openings via passages in said housing.

Preferably, liquid is sprayed from said outlet orifice means and said outlet openings in substantially transverse directions.

Preferably, said jet means are provided with grooves for passage of the said liquid and said liquid is then sprayed as mist via the said outlet orific s.

Preferably, said jet means are provided with an upper flange portion, an intermediate portion and a frusto-conical portion and said upper flange portion and said frusto-conical portion are provided with grooves along which said liquid can travel.

Preferably, said intermediate portion separates said upper flange portion and said frusto-conical portion and an annular space is formed between said intermediate portion and the wall of the chamber in which the said jet means is located.

Preferably, a housing cover part is provided and is removably engageable with the remainder of said housing and defines said liquid entry chamber with the remainder of said housing.

Preferably, said jet means are accessible by removing said housing cover part.

Preferably, bores or holes are provided in the said jet means for passage of said liquid therethrough.

Preferably, said bores in said jet means spray liquid from the same outlet orifices as the other liquid that travels around the said jet means.

In one arrangement, the nozzle is provided with a flat housing surface in which the outlet orifices are provided.

In an alternative arrangement, the nozzle is provided with a frusto-conical housing surface in which the outlet orifices are provided.

The nozzle of the present invention may be an automatic nozzle or a deluge nozzle.

The nozzle of the present invention can be installed, for example, in any location within an incident space, preferably on the ceilings of a space or side mounted on walls of the space to be protected by water mist. In some cases, local application of water mist nozzles may be practised whereby nozzles are directly positioned near the likely source of a fire, for example, near to an engine turbo or fuel injector system where a fire is likely to develop due to heat originating from a running motor.

The nozzle of the present invention may be used in a non-flammable liquid distribution pipe network for extinguishing a fire in an enclosed area such as in a machinery room or public and accommodation areas of a ship, in an aircraft hangar, in a building warehouse, in a tunnel, in an office building, in telecommunications rooms, in a electric generating room, on an oil platform, on electric transformers or in any other building or convenience where a fixed fire protection and extinguishing apparatus is required.

Whilst the nozzle of the present invention is herein described with particular reference to its use in non-flammable liquid distribution pipe network for extinguishing fires, it is to be understood that this is exemplary only and the nozzle of the present invention has general applicability to all other uses to which it is suited.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 is a schematic drawing depicting the combustion triangle and flow chain reaction circle;

Figure 2 shows a first embodiment of a nozzle in accordance with an aspect of the present invention shown connected to a non-flammable liquid distribution pipe network;

Figure 3a shows the nozzle shown in figure 2 with the housing cover part detached therefrom;

Figure 3b shows a swirl jet of the nozzle shown in figure 3a;

Figure 4 shows a second embodiment of a nozzle in accordance with an aspect of the present invention shown connected to a pipe of a non-flammable liquid distribution pipe network;

Figure 5a shows the nozzle shown in figure 4 with the housing cover part detached therefrom;

Figure 5b shows one of the swirl jets of the nozzle shown in figure 5a;

Figure 5c is an underside view of the nozzle shown in 5a in which the outlet orifices can be seen;

Figure 6a is an exploded view of a third embodiment of a nozzle in accordance with an aspect of the present invention;

Figure 6b shows a swirl jet of the nozzle showing figure 6a;

Figure 6c shows a plan view of a swirl jet positioned in a swirl chamber of the nozzle shown in figure 6a;

Figure 6d shows the glass bulb contained in the glass bulb housing assembly of the nozzle shown in figure 6a;

Figure 7 shows a cross sectional view of the nozzle shown in figure 6a;

Figure 8a is a further view of the nozzle shown in figure 6a with the glass bulb housing assembly detached th refrom;

Figure 8b shows the plunger mechanism of the nozzle shown in figure 8a; and

Figure 8c shows the glass bulb contained in the glass bulb housing assembly of the nozzle shown in figure 8a.

DESCRIPTION OF THE INVENTION

In figure 2, there is shown a nozzle 2 connected to a pipe 4 of a non-flammable liquid distribution pipe network. The nozzle 2 and component parts are shown in figures 3a and 3b.

The nozzle 2 comprises a housing 6, swirl chambers 8 provided in the housing 6 and a swirl jet 10 provided in each chamber 8. The housing 6 is provided with outlet orifices 12 corresponding to each chamber 8. Liquid pumped to the nozzle 2 travels into the chambers 8 and is atomised by the jets 10 such that liquid is sprayed as a mist from the nozzle 2 via the outlet orifices 12.

In figure 3a, the nozzle 4 is shown as having seven swirl chambers 8. However, any suitable number of swirl chambers 8 may be provided. Normally there would be at least three swirl chambers 8. A jet 10 is provided in each of the swirl chambers 8.

An outlet orifice 12 is provided for each swirl chamber 8.

The swirl jets 10 are removably engaged in their respective swirl chambers 8. For example, this may be done by providing a screw thread 14 on the jets 10 which engages with corresponding screw threads (not shown) in the walls of the respective chambers 8.

A liquid entry chamber 16 is formed in the housing 6 between the surface 18 in the housing 6 and a housing cover part 20. The housing cover part 20 is removably attached to the r maind r of the housing 6. This may be done for example, by screw threads 22 on the housing cover part 20 engaging with corresponding screw threads 24 on the remainder of the housing 6. The liquid entry chamber 16 is best seen in figure 7, to be later herein described.

The jets 10 have grooves 26 and 28 for passage of liquid. The groove 26 is provided in an upper flange portion 30 of the jet 10. The jets 10 further comprise a frusto-conical portion 32 and an intermediate portion 34 between the upper flange portion 30 and the frusto-conical portion 32. The intermediate portion 34 separates the upper flange part 30 and the frusto-conical portion 32 and an annular space 35 is formed between the intermediate portion 34 of the jet 10 and the corresponding swirl chamber 8.

The groove 26 enables a screw driver to be inserted therein for removal and insertion of the jets 10 into their respective swirl chambers 8. In addition, the groove 26 allows passage of liquid into the annular space 35 (previously hereinbefore described) in the swirl chambers 8 between the intermediate portion 34 of the jets 10 and the wall of the swirl chambers 8. The liquid is able to travel from the annular space along the grooves 28 to respective outlet orifices 12. The liquid is atomised as it travels through the groove 26, annular space 35 and groove 28 in each chamber 8 and is sprayed as a mist from the respective outlet orifice 12.

The jets 10 are readily accessed by removal of the housing cover part 20. The housing cover part 20 is provided with a fitting 36 which is connectable with a T-piece fitting 38 of the pipe 4. The fitting 36 is provided with an inlet 40 to enable liquid to travel from the pipe 4 into the liquid entry chamber 16 of the nozzle 2.

The jets 10 may be provided with a bore, or hole, 42 extending substantially longitudinally therethrough. The bore extends from the groove 26 through the intermediate portion 34 and the frusto-conical portion 32. Liquid is thereby also able to travel through the bore 42. Liquid travelling through the bore 42 exits via the same outlet orifice 12 as the liquid that travels along the groove 26, annular space 35 and groove 28 of each jet 10.

The nozzle 2 may also be provided with passages 44 (shown in figure 7) which extend from the liquid entry chamber 16 to outlet openings 46 on the outside surface of the housing 6. The passages 44 are provided with inlet openings 48 in the surface 18 of the housing 6.

The outlet openings 46 are provided in a portion 49 of the housing 6 which is cylindrical.

The outlet orifices 12 are provided in a frusto-conical portion 50 of the housing 6.

In figures 4, 5a and 5b, there is shown a nozzle 60 in accordance with a second embodiment of the present invention.

The nozzle 60 is substantially similar to the nozzle 2 shown in figures 2, 3a and 3b and similar reference numerals are used in figures 4, 5a and 5b as were used in figures 2, 3a and 3b for corresponding parts. It is to be understood that the description of those parts is the same as previously hereinbefore described with reference to figures 2, 3a and 3b.

The difference between the nozzle 60 and the nozzle 2 is that the nozzle 60 does not have a frusto-conical portion 50 in which the outlet orifices 12 are provided. Instead of the frusto-conical portion 50, the nozzle 60 is provided with a substantially flat portion 62 recessed from the outer edge of the remainder of the housing 6. The outlet orifices 12 are provided in the under surface of the portion 62 as can be seen in figure 5c.

In other respects, the nozzle 60 is as described previously herein in relation to the nozzle 2.

The effect of the frusto-conical portion 50 of the nozzle and the portion 62 of the nozzle 60 means that the nozzles 2 and 60 have different spray patterns. In that regard, the nozzle 2 has a wider spray pattern than the nozzle 60. For example, depending upon the taper angle of the frusto-conical portion 50, the nozzle 2 has a spray pattern of approximately 130°. In contrast, the nozzle 60 has a narrower spray pattern of approximately 70°.

However, the above spray pattern angles are provided by way of example only and other spray angles may be provided and the nozzles configured appropriately.

In use, nozzles of the present invention are connected to the pipes 4 of a non-flammable liquid distribution pipe network installed of a fire incident area requiring protection. The distribution pipes are designed according to hydraulic principles whereby the system is engineered to deliver the correct amount of non-flammable liquid under a specified pressure and according to liquid flow rates to yield an optimal flux density to achieve fire extinguishment. The distribution pipe network is rigidly affixed onto the ceilings, walls or in local regions where fires are expected to develop. Any number of nozzles may be used having regard to the engineering designs for optimal flow rates and flux densities to achieve fire extinction. The type and size of nozzles, including their placement within a fire incident area, is designed according to hydraulic calculations and engineering design principles.

Non-flammable liquid is introduced into the distribution pipe network either from self-contained storage cylinders under elevated pressure, typically 20 Bar, or via fire pumps which operate at required design pressures for the system, eg 20-22 Bar. Other pressures may be used below 20 Bar, for example as low as 5 Bar

pressure, or higher pressures above 20 Bar such as up to 100 Bar, may be used.

The nozzle of the present invention may be used with any design pressure possible.

The nozzles may be manufactured in different sizes and dimensions, having various K-factors and result in flux densities. Liquid flows for different nozzles vary according to the operating pressures, the size of the orifices, the size of nozzles and other operating parameters. Flow rates can be as low as 3 litres per minute or as high as 3,600 litres per minute. The nozzle of the present invention may be used with any required flow rate capacity including those below and above the aforesaid rates.

The nozzle of the present invention may be made from various metallic ores, eg copper, brass, stainless steel, and titanium.

The manner of use of the nozzle of the present invention will now be described.

As previously hereinbefore described, the nozzles may be affixed to the distribution pipe network by screw threading into the pipes. When a nozzle of the present invention is activated, liquid flows from the pipe 4 through the opening 40 and into the liquid entry chamber 16. The liquid then flows through the swirl chambers 8 in a swirling fashion due to the presence of the grooves 26 and 28 and the annular space 35. This swirling action results in the liquid being sprayed from the outlet orifices 12 as a mist.

In the case of the swirl jets 10 being provided with bores 42, the liquid travelling under elevated pressure through a bore 42 causes a rifling effect within the swirl chamber 8 and induces the liquid to exit the swirl chamber 8 via the outlet orifice 12 under greater speed. Increased speed means that the liquid atomisation is enhanced and the liquid mist trajectory is considerably improved.

The bore 42 may, for example, be of approximately 2mm in diameter.

Furthermore, when the bores 42 are present, the spray pattern created from the outlet orifices 12 is a "solid spray" pattern, whereas without the bores 42 being provided in the swirl jets 10, the spray pattern from the outlet orifices 12 is a "hollow spray" pattern. A solid spray pattern has the advantage that a more uniform mist distribution is created yielding an improved flux density which causes improved fire extinguishment and enhanced cooling effects.

Provision of the bore 42 through the swirl jet 10 also provides a wider spray pattern at floor level. This increases the resultant flux densities and aids in fire extinguishment. The presence of the bore 42 also means that more liquid discharges through the same size nozzle without having to increase the size of the outlet orifices 12.

As an example, tests performed on nozzles using orifice dimensions of nominal 1.4mm diameter and swirl jets 10 with no bores 42 being provided yielded flow rates of 6.3 litres per minute at 10 Bar operating pressure. The same nozzle with bores 42 having diameters of 2mm provided in the swirl jets 10 yielded flow rates of 9.3 litres per minute at similar pressures.

The provision of the bores 42 in the swirl jets 10 provides enhanced penetration of liquid mist into the uprising heat effect currents originating from the fire plume and provides extinguishment of fires in shorter time spans.

Even without the bores 42 being provided, the liquid expelled from the outlet orifices 12 of the nozzles is expelled under elevated pressure and into the fire incident area. The liquid under pressure creates a mist and the mist will be expelled in an outward trajectory at various distances from the nozzle and into the spaces being protected against fire. The nozzle of the present invention has a droplet size which enhances its trajectory into the fire plume and base of the fire, thus increasing its latent heat absorption properties. The mist droplet sizes

can have diameters from approximately 1 micron up to 1,000 microns. However, droplet sizes smaller and greater than the aforesaid lower and upper limits are also embodied by the nozzle of the present invention.

When the nozzle of the present invention is used in a distribution pipe network, the non-flammable liquid may be water. Fresh water, distilled water or sea water may be used. To further aid in extinguishing fires, a fire fighting chemical can be added to the non-flammable liquid. For example, a suitable fire fighting chemical is an aqueous film forming foam.

The nozzle of the present invention may be provided as an automatic mist nozzle or as a deluge mist nozzle.

An automatic mist nozzle uses a frangible quartzide glass bulb for activation of the nozzle upon heat causing the glass bulb to break thereby causing liquid mist to be propelled into the fire incident area.

The deluge mist nozzle does not depend upon shattering of a glass bulb to cause liquid mist to discharge into the incident area. A deluge mist nozzle may be activated by a smoke/fire sensor or detector. A deluge nozzle entails a "dry pipe" distribution network in which water begins to flow through the pipes and out of the nozzles upon activation of the system.

Figures 6a-8c show a third embodiment of a nozzle 70 in accordance with the present invention.

The nozzle 70 is similar to the nozzle 2 shown in figures 2-3b except that it is provided with a frangible quartzide glass bulb 72 for activation of the nozzle 70 upon heat causing the glass bulb 72 to break thereby causing liquid to flow through the nozzle 70 and into the fire incident area.

The glass bulb 72 is provided in a housing assembly 74. The nozzle 70 is also provided with a plunger mechanism 76. The plunger mechanism 76 has a cupped rubber seal 78 with an O-ring 80.

The frusto-conical portion 50 of the nozzle 70 is provided with a recess in the lower surface therein such that the housing assembly 74 can be screw threadedly engaged with the housing 6 via the screw thread 82 on the housing assembly 74 and a screw thread 84 in the recess in the frusto-conical portion 50 of the housing 6.

An O-ring 86 is provided between the housing assembly 74 and the housing 6 of the nozzle 70.

The plunger 76 is able to move such that when the glass bulb 72 breaks, the plunger 76 moves downwardly under the back pressure of the liquid and moves down into the housing assembly 74. This allows liquid to flow through the inlet 40 and the passage 88 into the liquid entry chamber 16, from which point operation is similar to that previously herein described.

The outlets 46 provided on the side of the housing 6 of the nozzles enable a fine mist of liquid to spray substantially radially and at a substantially 360° spray angle close to the ceiling level in which the distribution pipe network is situated. Spraying from the outlets 46 occurs simultaneously with the spraying of liquid through the outlet orifices 12, which spray mist substantially downwardly in the case of the distribution pipe network being ceiling mounted. The directions of spray from the outlets 42 and the outlet orifices 12 are substantially transverse to one another. The provision of the openings 46 provides improved fire extinguishment. As the mist spray travels along the under side of the ceiling (assuming the nozzles are ceiling mounted) or along the walls of a room or compartment (in the case of the nozzles being wall mounted) thereby greatly preventing the spread of fire to these areas.

Provision of the outlets 46 directing mist spray in the pattern hereinbefore described lowers the ceiling gas temperature which means there is less chance of the flash-over phenomenon occurring within the fire incident area.

The outlet openings 46 may be provided as a series of thin slits or grooves spaced around the outside surface of the housing 6. These slits or grooves may have narrow air gap dimensions of approximately 0.5mm-1.0mm, although different size nozzles will require different size air gap dimensions.

Since the swirl jets 10 are removably engaged in the housing 6 of the nozzles of the present invention, this enables swirl jets 10 to be interchangeable between nozzles of the same size which means that it is not necessary to manufacture complete new nozzle housing assemblies for different nozzles. This results in less expensive production costs. Interchangeability of swirl jets 10 also means that servicing of nozzles is easier and, should a system need to be upgraded, it can be done with less cost than otherwise.

Whilst the nozzle of the present invention has been particularly described with reference to its use in fire extinguishment application, it is to be understood that this is exemplary and the nozzle may be used for all other applications for which it is suitable and the disclosure herein is not to be limited to only fire extinguishment applications.

Modifications and variations such as would be apparent to a skilled addressee are deemed to be within the scope of the present invention.

CLAIMS

1. A nozzle for spraying liquid characterised in that it comprises a housing, chambers provided in said housing, jet means provided in a respective said chamber, said housing having outlet orifice means corresponding to each said chamber, wherein liquid delivered to said nozzle travels into said chambers and is substantially atomised by said jet means such that said liquid is sprayed as a mist from said nozzle via said outlet orifice means.

2. A nozzle according to claim 1, characterised in that at least three said chambers are provided in said housing.

3. A nozzle according to claim 1 or 2, characterised in that said outlet orifice means comprises an outlet orifice such that liquid can be sprayed from each said chamber via its outlet orifice.

4. A nozzle according to any one of claims 1 to 3, characterised in that said jet means are removably retained in said chambers.

5. A nozzle according to any one of claims 1 to 4, characterised in that, in use, said jet means are stationary in said housing.

6. A nozzle according to any one of claims 1 to 5, characterised in that a nozzle inlet and liquid entry chamber means are provided such that liquid is introduced into said liquid entry chamber means via said nozzle inlet.

7. A nozzle according to claim 6, characterised in that liquid is able to pass from said liquid entry chamber means into said chambers.

8. A nozzle according to claim 6 or 7, characterised in that said housing is provided with passage means for flow of liquid having inlet means opening

into said liquid entry chamber means and outlet means provided on the exterior of said housing.

9. A nozzle according to claim 8, characterised in that said outlet means of said passage means is arranged such that liquid is sprayed from said nozzle in a direction substantially transverse to the direction of spray of liquid from said outlet orifices.

10. A nozzle according to claim 8 or 9, characterised in that said outlet means of said passage means is arranged such that liquid is sprayed substantially radially from said nozzle.

11. A nozzle according to any one of claims 8 to 10, characterised in that said passage means comprises a series of passages and said inlet and outlet means comprises a series of inlets and outlets of respective said passages.

12. A nozzle according to any one of claims 8 to 11, characterised in that said outlet means of said passage means is substantially slit shaped.

13. A nozzle according to any one of claims 1 to 12, characterised in that said liquid is sprayed from said outlet orifice means in a spray pattern angle of up to substantially 180°.

14. A nozzle according to any one of claims 1 to 13, characterised in that said jet means are provided with grooves for passage of liquid which is then sprayed from said nozzle.

15. A nozzle according to claim 14, characterised in that said jet means are provided with an upper portion, an intermediate portion and a frusto-conical portion and said grooves are provided in said upper portion and said frusto-conical portion.

16. A nozzle according to claim 15, characterised in that an annular space is formed between the wall of said chamber means and said intermediate portion for passage of liquid.

17. A nozzle according to any one of claims 1 to 16, characterised in that said jet means are provided with bore means extending therethrough for passage of liquid.

18. A nozzle according to claim 17, characterised in that liquid is able to travel through said bore means and exit said nozzle means via said outlet orifice means.

19. A nozzle according to claim 17 or 18, characterised in that said bore means extends through said intermediate portion and said frusto-conical portion, such that liquid is able to enter said bore means at said intermediate portion and exit at said frusto-conical portion.

20. A nozzle according to any one of claims 1 to 19, characterised in that detachable housing cover means is provided which defines said liquid entry chamber with the remainder of said housing.

21. A nozzle according to claim 20, characterised in that said jet means can be accessed by first removing said housing cover means.

22. A nozzle according to any one of claims 1 to 21, characterised in that said outlet orifice means is provided on a frusto-conical portion of said housing.

23. A nozzle according to any one of claims 1 to 21, characterised in that said outlet orifice means is provided on a substantially flat portion of said housing.

24. A nozzle according to any one of claims 1 to 13, characterised in that a frangible member is provided to activate said nozzle upon said frangible member breaking.

25. A fire extinguishing pipe distribution network for delivering non-flammable liquid characterised in that it includes at least one nozzle as defined in any one of claims 1 to 24.

Combustion Triangle

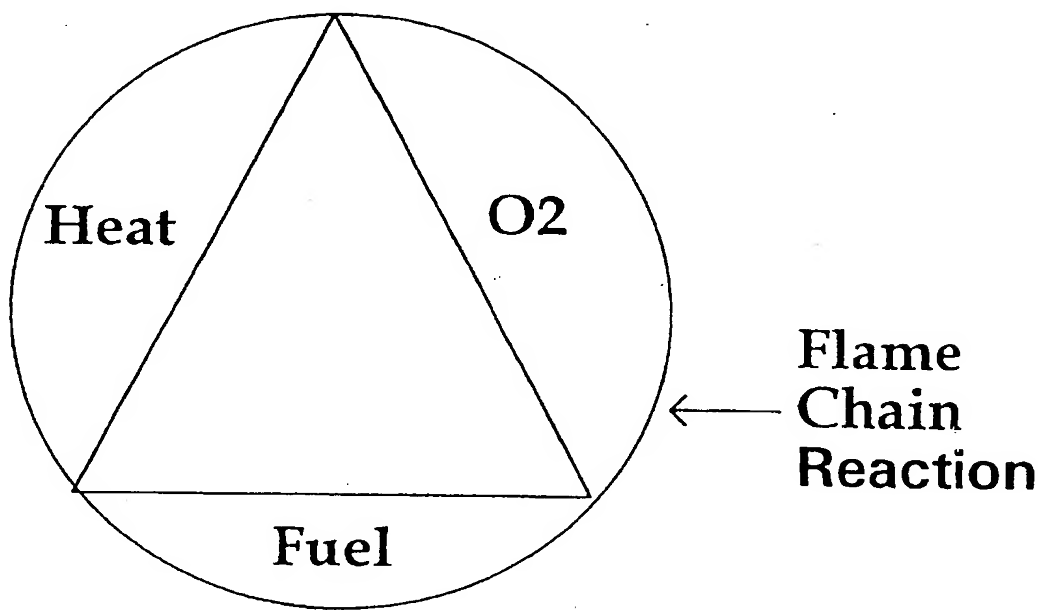


Figure 1.

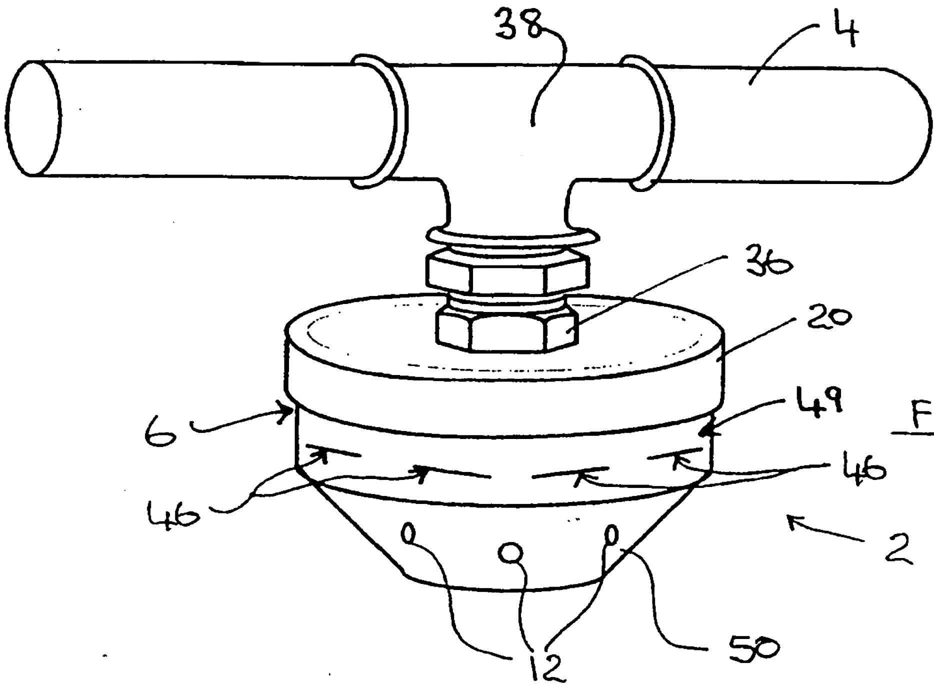


FIG. 2

FIG. 3a

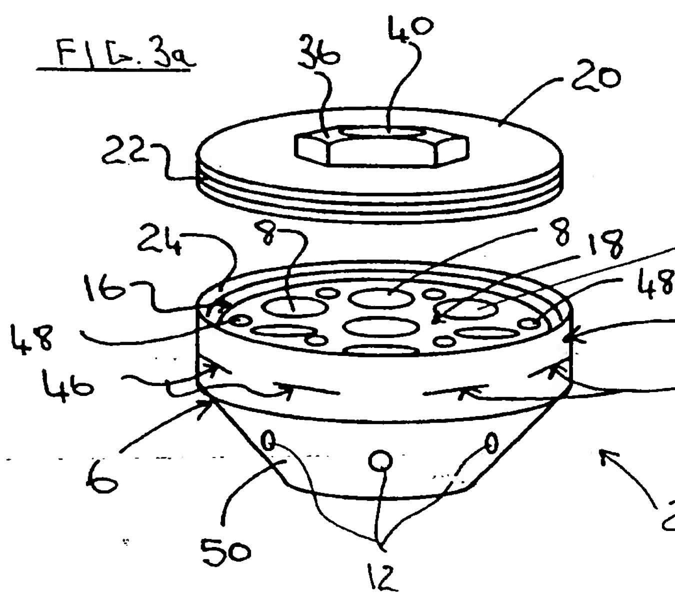
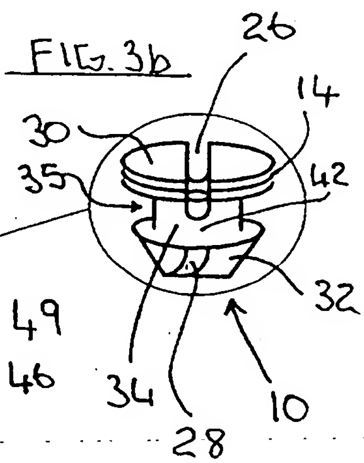


FIG. 3b



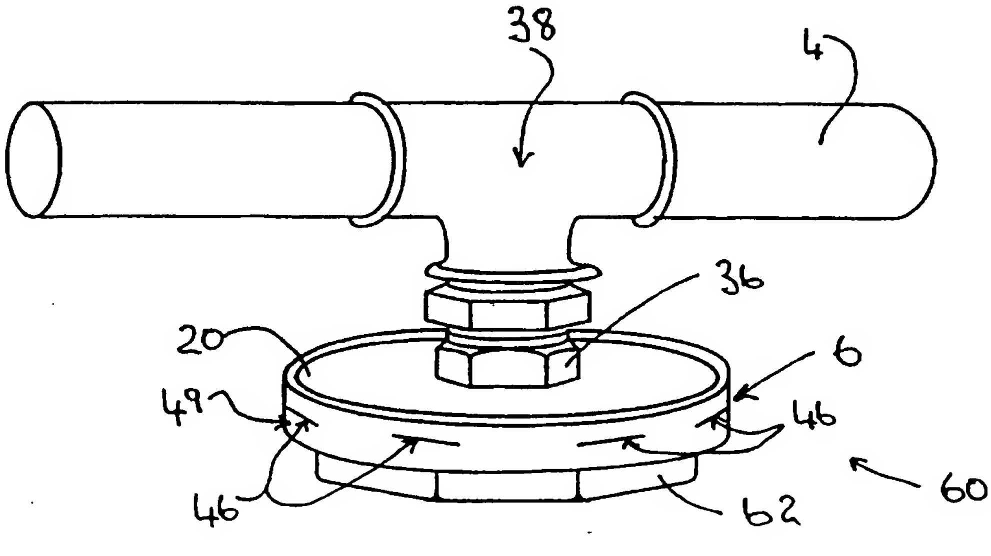


FIG.4

FIG.5a

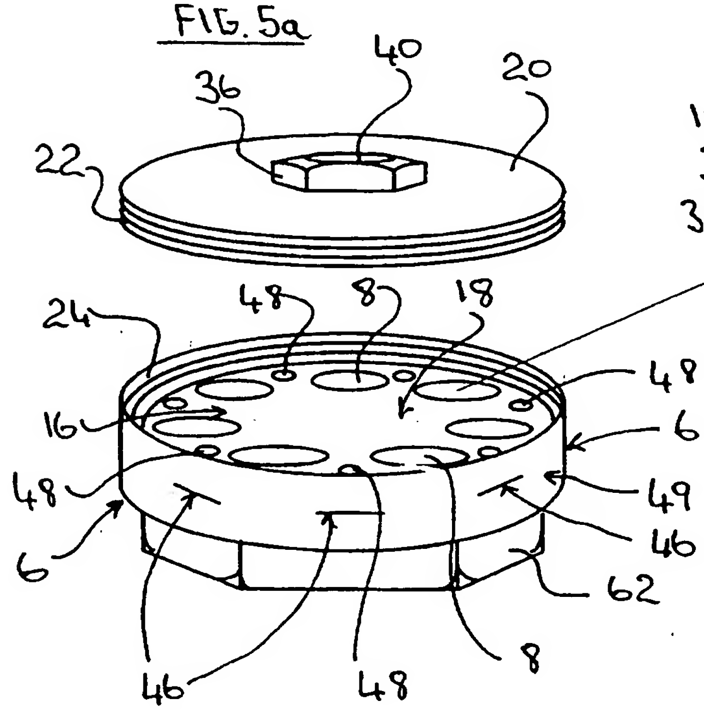
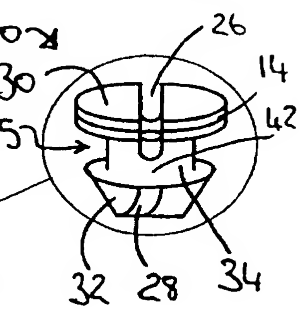


FIG.5b



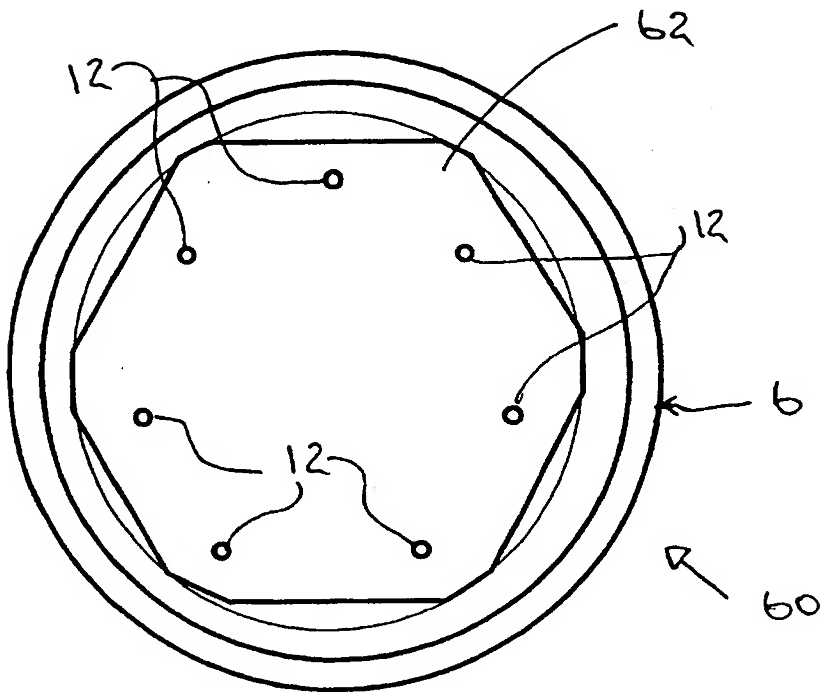


FIG. 5c

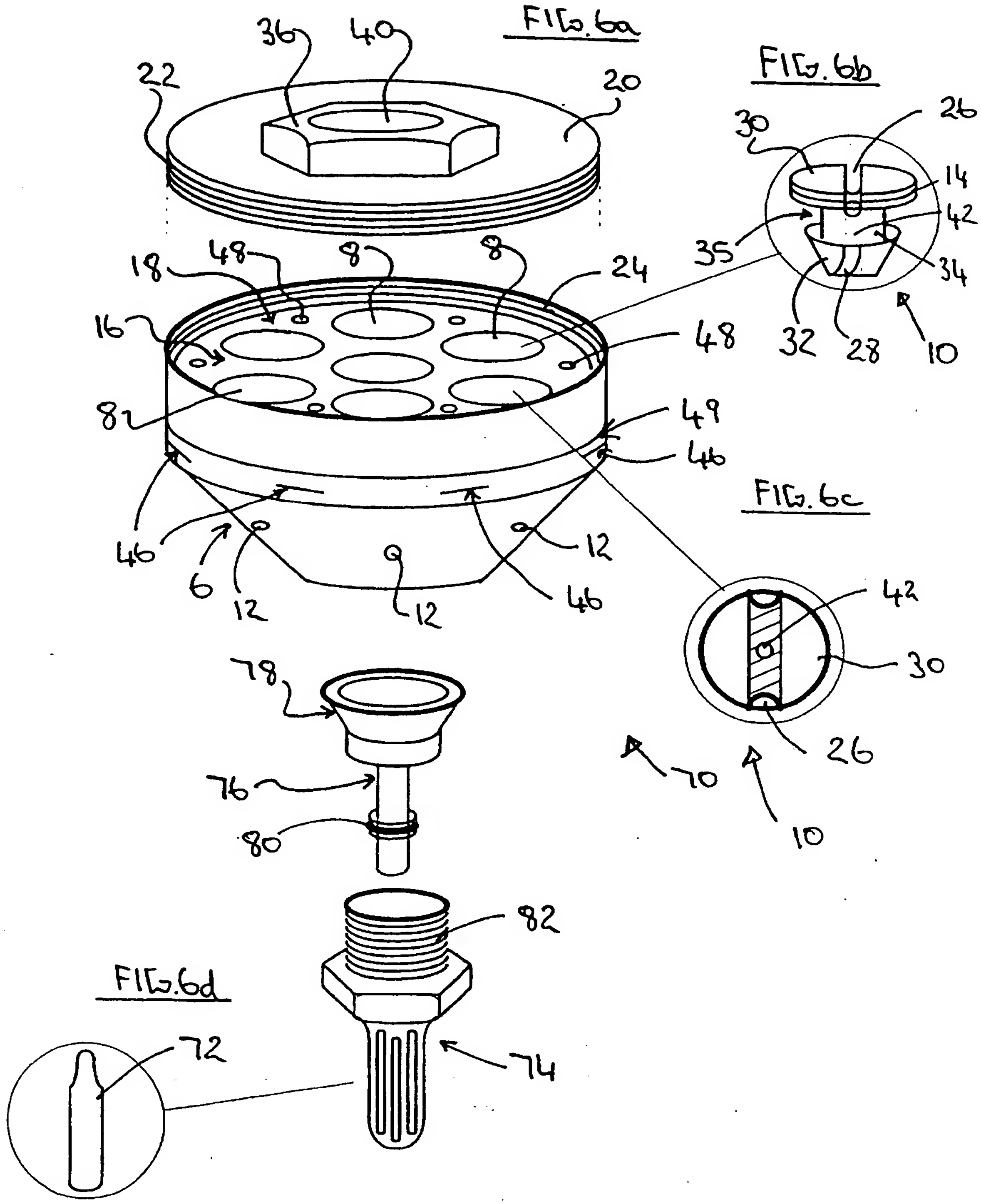


FIG. 6a
FIG. 6b
FIG. 6c
FIG. 6d
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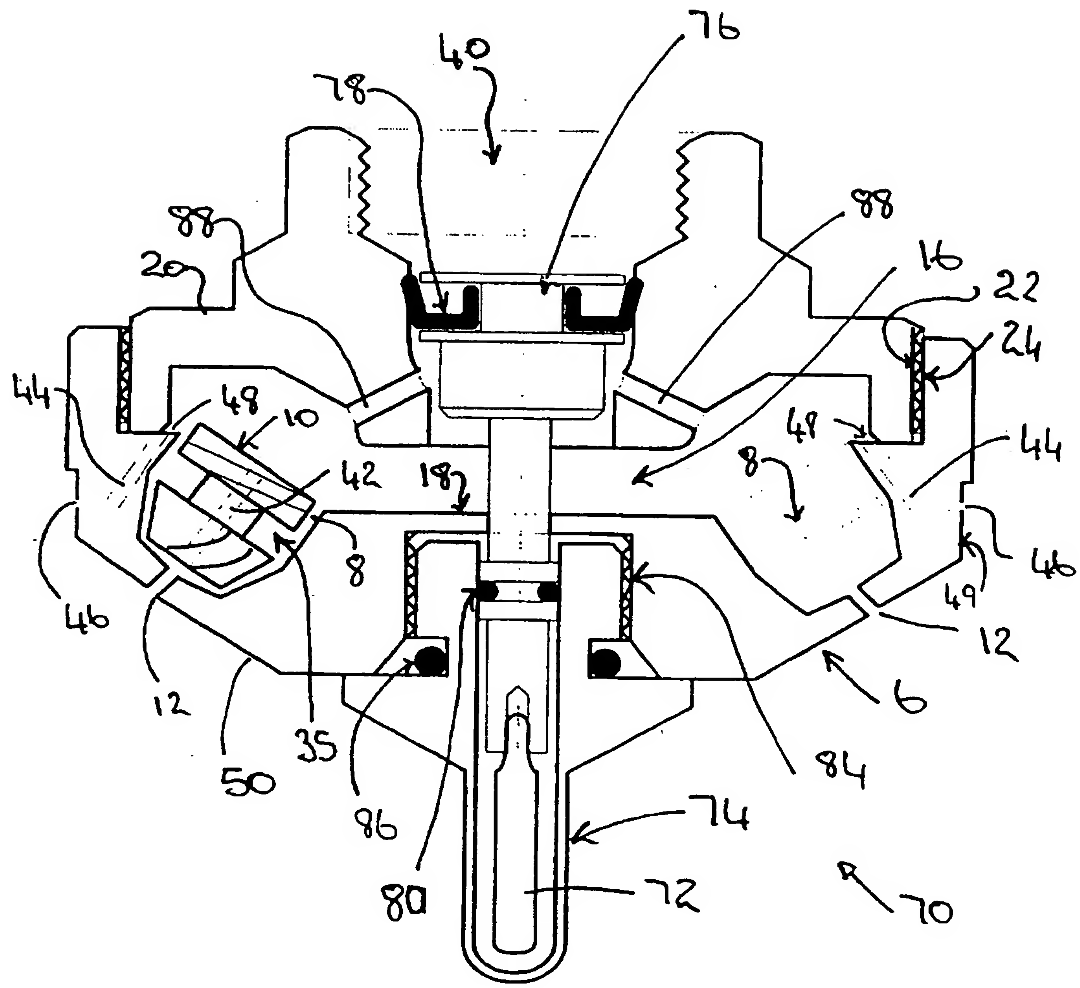
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FIG. 7

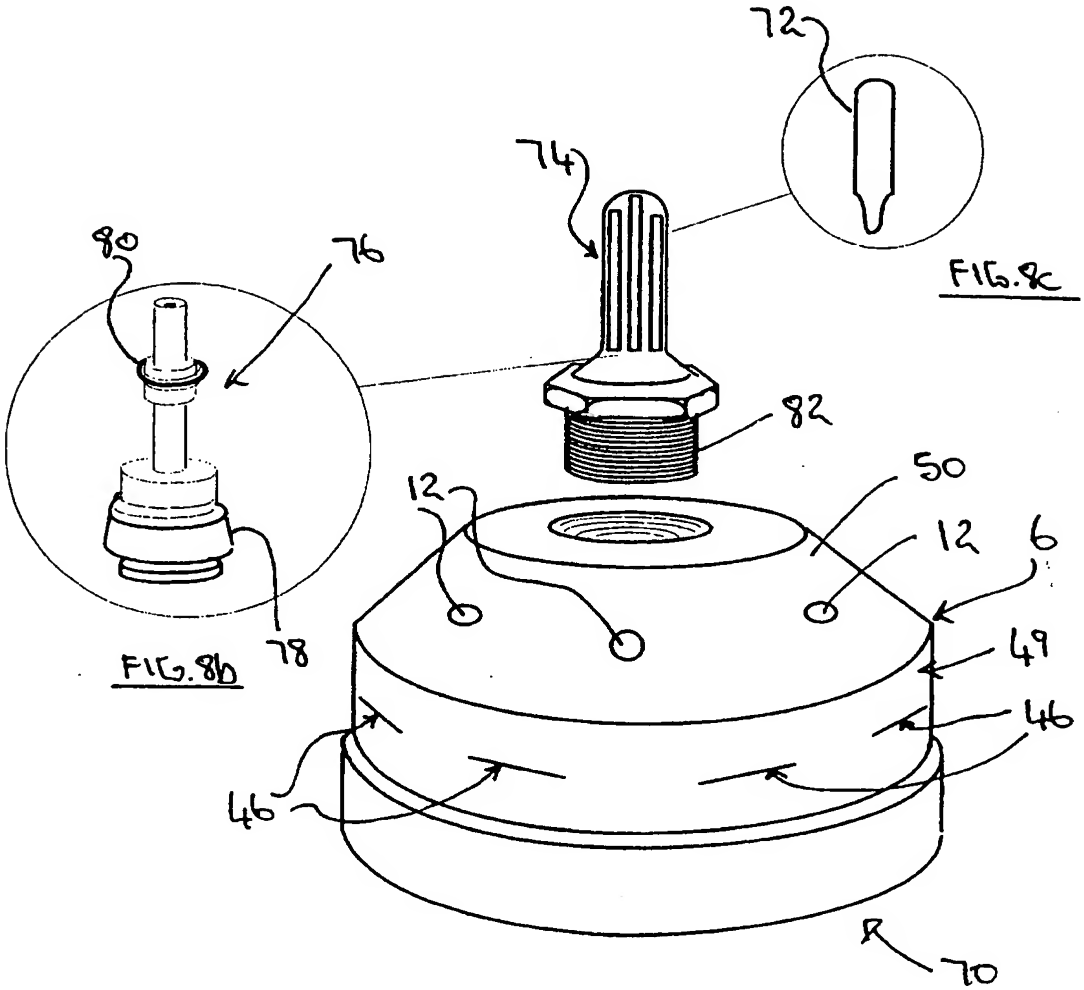

FIG. 8a

INTERNATIONAL SEARCH REPORT

International Application No.
PCT/AU 97/00288

A.	CLASSIFICATION OF SUBJECT MATTER
Int Cl[6]:	B05B 1/02, 1/14, 1/34; A62C 35/68

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC (6) - B05B 1/02,1/14,1/34; A62C 35/68
IPC (4) - A62C 35/34

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Derwent WPAT & JAPIO - all IPC marks above with keywords "MIST: or FOG: or FINE: or ATOMIS: or ATOMIZ:"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3128048A, (DENURE) 7 April 1964. See column 1, lines 12, 14-19, column 2, lines 13-32	1-11, 14
X	DE, 324589A, (WAGNER) 1 September 1920	1-11, 14
X	DE, 3440901 A1, (VEB Metalleich..) 11 July 1985	1-11, 14
A	DE, 3243230 A1, (CONRAD) 24 May 1984	
A	SU, 1371714A, (DEMIN) 7 February 1988 Derwent English Language Abstract, Accession no. 88-241195, Week 8834, class P4, page 2	

☐ Further documents are listed in the continuation of Box C ☐ See patent family annex

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
23 May 1997	30 MAY 1997
Name and mailing address of the ISA/AU AUSTRALIAN INDUSTRIAL PROPERTY ORGANISATION PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No.: (06) 285 3929	Authorized officer David Lee Telephone No.: (06) 283 2107

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No.
PCT/AU 97/00288

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member	
DE	3440901	HU	39102

END OF ANNEX